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# MOLECULAR RESONANCE STIMULATED BY LOW INTENSITY LASER LIGHT

## Molecular Resonance

The present invention relates to molecular resonance of molecules, in particular molecular resonance generated by laser radiation.

The concept of introducing high Q molecules that may be stimulated by laser light to deliver toxic or therapeutic effects is known from Dunlavy US5313315. However, the direct stimulation of natural biological processes by means of molecular resonance using modulated or selective wavelength lasers has hitherto proved to be impossible. This is because of the scattering nature of the medium, the close proximity of many resonances in natural molecules and the difficulty of differentially raising the temperature and thereby the reactivity of individual desired molecules.

1 The present invention defines an apparatus and method

2 which overcomes some of these problems and covers the

3 nature and type of molecule susceptible to

4 differential stimulation.

5

6 Many critical chemical reactions in the body are

7 functions of the Cell Surface Cell Adhesion Molecules

8 that are in turn moderated by various integrins. The

9 geometric structure of many Cell Adhesion Molecules

10 and particular integrins is such that they are

11 capable of supporting a resonance at relatively low

12 frequency and surprisingly high Q. Unlike most

13 protein structures which are heavily damped or

14 inherently rigid in structure these molecules

15 generally take the form of a pair of relatively rigid

16 structures separated by space often bridged by a

17 single strand. This structure is especially sensitive

18 to periodic stimulation by a laser source especially

19 when the molecule surface is neutral or slightly

20 negatively charged. The polar and hydrophobic regions

21 of the molecule also differentially absorb energy

22 from laser light. This causes brief alterations in

23 both the structural bond energy and consequently

24 tends to amplify the vibration of the molecule. The

25 effect of this is to slightly increase the chemical

26 reactivity of particular molecules on a cell surface

27 relative to the surrounding molecules of a more

28 generally damped structure or other high Q molecules

29 of a different resonant frequency.

30

1 In vivo the scattering of light at suitable
2 excitation wavelengths is extreme and as a result
3 even quite low frequency modulation signals tend to
4 be corrupted by the multiple scatter path lengths and
5 by the delay in absorption and release of photons in
6 those atoms at low energy states.

7

8 Also if continuous laser radiation is delivered to a
9 mass of cells the high damping factor of the
10 structure means that in general the overall
11 temperature of the cell mass rises. This occurs even
12 if modulated at the resonant frequency of a
13 particular molecule. The use of laser radiation in
14 this way produces an increase in the reactivity of
15 the entire cell surface which means that no actual
16 change in the reaction products occur because the
17 cells are in general, at equilibrium.

18

19 Conversely if very low energy is delivered at the
20 resonance frequency of the cell adhesion molecules or
21 if energy can be delivered as an intermittent pulse
22 of extremely short duration, the cell adhesion
23 molecules and the integrins with their inherently
24 high Q structure tend to maintain a slightly higher
25 temperature than the surrounding molecules. Thus the
26 cell adhesion molecules can be stimulated to a
27 greater reactivity than the surrounding surface
28 molecules.

29

1 Many biological processes can be disturbed into a

2 cascade of increasing reactivity if an initial

3 response is initiated. The immune response is a

4 powerful example of this but the nature of biological

5 reactions on the cell surface means that similar

6 cascade reactions occur for a wide variety of initial

7 conditions disturbed from equilibrium. Thus a very

8 small change in the reactivity of a surface molecule

9 for a short time can result in a dramatic change in

10 the chemistry of the cell surface for a considerable

11 period after the stimulation.

12

13 This effect depends on the cell chemistry being

14 substantially in equilibrium at the commencement of

15 the delivery of the radiation, otherwise the

16 resonance effect will tend to be swamped by the

17 current dominant reaction. Thus the target cells must

18 be in a relatively neutral pH environment and

19 obviously not engaged in a vigorous metabolic

20 process. Ideally also the cell surface molecule would

21 be neutral or slightly negative as this increases the

22 absorption of photons and so increases the transfer

23 of energy from the laser to the molecule.

24

25 Although this limits the use of this method, it has

26 one beneficial effect with respect to therapeutic use

27 in carcinomas. The undifferentiated cells of a

28 carcinoma are generally at equilibrium on the surface

29 as most of the chemical energy of the cell is

1   expended internally in the cell duplication process.

2   This means that the undifferentiated cells of a

3   carcinoma are particularly susceptible to the effect

4   of the method on the surface chemistry since by their

5   nature they conform to the ideal requirements for low

6   energy disturbance of the equilibrium.

7

8   It is a critical requirement of this effect that the

9   initial stimulation is periodic and of very low

10   overall energy, as higher energy stimulation would

11   merely raise the temperature of the entire cell by

12   conduction and would not change the reaction

13   equilibrium. To achieve such a change, individual

14   molecules on the cell surface must be at different

15   temperatures. Ideally it would consist of small,

16   directed bursts of light modulated at the frequency

17   of the desired molecule. Unfortunately it is clearly

18   impossible to direct such a beam in the highly

19   scattering medium of a living human body.

20

21   If a conventional laser or simple light beam is

22   directed at a highly scattering medium, the

23   modulation is eliminated at any substantial frequency

24   because the light paths to any given point are so

25   numerous and of such differing lengths that any

26   modulation is reduced to noise after a few

27   millimetres of the scattering medium. Even at lower

28   frequencies the general level of overall energy

29   delivered to the cells means that conduction and

1 convection tend to raise the overall temperature of

2 the cell surface rather than allow isolated

3 temperature differences to exist for any useful

4 length of time. Further it is impractical to generate

5 a light pulse which is of sufficiently short duration

6 and with a sufficiently high pulse repetition

7 frequency to be of practical use in the stimulation

8 of any resonance of a Q likely to occur in a living

9 cell surface molecule.

10

11 This invention provides a means of differentially

12 stimulating at least those molecules susceptible by

13 their structure to resonant stimulus.

14

15 The invention and preferred features thereof are

16 defined in the appended claims.

17

18 Embodiments of the invention will now be described,

19 by way of example only, with reference to the

20 drawings, in which:

21

22 Fig. 1 is a block diagram of an apparatus

23 embodying the invention;

24 Fig. 2 illustrates an interference pattern

25 produced by the apparatus of Fig. 1;

26 Fig. 3 shows the same interference in a scattering

27 medium;

1     Figs. 4 and 5 show typical cell adhesion

2   molecules;

3     Fig. 6 shows a human integrin molecule with a

4   single substantial high Q resonance;

5     Fig. 7 shows the zinc structure of the GAG protein

6   in the HIV virus; and

7     Fig. 8 shows a typical laser diode spectrum.

8

9   Referring to Fig. 1, the apparatus comprises a laser

10  diode 2 which is controlled by an amplitude modulator

11  1.  The laser diode 2 is selected to have a

12  reasonably linear relationship between current and

13  wavelength with minimum mode hopping.  The amplitude

14  modulator 1 modulates the current to the laser diode

15  2which in turn results in a very small wavelength

16  modulation of the laser, for purposes discussed

17  below.

18  The output of the laser diode 2 is collimated by a

19  lens 3 and passed to an optical element 4.  The

20  optical element 4 consists of a first diffraction

21  grating, a refractive element, and a second

22  diffraction grating such that the beam is

23  substantially cancelled.  A preferred form of the

24  optical element 4 is as disclosed in WO97/22022 (now

25  EP-A1-0865618A and US-A-6064500). This allows the

26  cancellation to occur over a small percentage of the

27  wavelength variance of the laser source, rather than

28  at a single critical wavelength. Wavelengths beyond

29  the acceptance bandwidth of the cancelling optic 4

1   above and below the centre frequency pass without

2   being cancelled. This means that a complex Fresnel /

3   Fraunhoffer zone will be generated, defined by the

4   beat frequency of the high and low frequencies as a

5   function of the aperture. This means that relatively

6   sparse zones of constructive interference will occur

7   between the high and low frequency passes of the

8   cancellation element in selected directions from the

9   aperture, as shown in Fig. 2.

10

11  As seen in Fig. 1, the optical element can be

12  adjusted angularly between positions 4A and 4B. This

13  varies the ratio of constructive to destructive

14  interference.

15

16  In effect the continuous beam is transformed into a

17  string of extremely short duration pulses typically

18  of sub femto second duration. The small wavelength

19  modulation of the laser diode 2 causes the

20  constructive and destructive nodes to move rapidly

21  through the volume of the Fresnel zone of the

22  collimator lens aperture. This has the effect of

23  simulating very short (sub picosecond) pulse

24  behaviour at any point in the Fresnel zone through

25  which the nodes pass at a pulse repetition frequency

26  defined by the amplitude modulator frequency.

27

28  The wavelength of the cancellation and constructive

29  interference zones for a theoretical single path

1 would be the difference between the two frequencies.

2 If the bandwidth of the cancelling element is narrow

3 this difference is very small and the effective

4 wavelength of the cancelled / non-cancelled cycle

5 would be very long, of the order of pico-seconds.

6 Therefore, the system would behave substantially

7 similarly to a system with no cancellation because it

8 requires an aperture much larger than the primary

9 light wavelength to generate a useful Fresnel /

10 Fraunhoffer zone. Such an aperture would greatly

11 multiply the available Feynman diagram paths

12 eliminating any useful effect, even if it were

13 possible to generate a sufficiently coherent source

14 of such an aperture.

15

16 If the beat frequency can be made high enough the

17 wavelength of the cancelled to non-cancelled cycle

18 can be a fraction of a practical aperture. This will

19 make this wavelength sufficiently small to limit the

20 Feynman paths to within a cycle or two in free space

21 allowing the Fresnel / Fraunhoffer effect to be

22 apparent. Since the centre frequency and spectrum

23 spread of a laser diode is easily modulated by

24 adjusting the current and or temperature of the

25 junction, the pattern of the Fresnel / Fraunhoffer

26 zones can be varied dramatically by very small

27 variations in the wavelength of one or both pass

28 frequencies. Such modulation is produced in the

29 apparatus of Fig. 1 by the amplitude modulator 2.

30

1  Ideally the diode is modulated only slightly so that
2  the frequencies of the laser spectra move by an
3  amount smaller than that which would cause a second
4  lobe to spill outside the bandpass of the
5  cancellation element. As described above the aperture
6  of the apparatus has a dimension some substantial
7  multiple of the wavelength of the laser and some
8  significantly smaller multiple of the cancellation
9  cycle. Thus the number of different Feynman diagram
10  path lengths will be substantially less than infinite
11  for any given cycle length. Thus as different rays
12  from the laser take slightly different paths through
13  the optical element and thereafter cause the complex
14  Fraunhoffer zone within the beam the pattern
15  generated is the inverse of a typical narrow spectrum
16  Fraunhoffer zone.

17

18  Therefore, instead of the centre frequencies of the
19  beam being in general uncancelled, the centre
20  frequencies are totally cancelled. Thus instead of a
21  general constant level of light in the beam, the beat
22  frequency beam is characterised by isolated
23  relatively sparse "islands" of constructive
24  interference occurring in the generally cancelled
25  beam. Small variations in the centre frequency of the
26  laser as a result of modulation of the current or
27  temperature of the diode cause these islands of
28  constructive interference to move rapidly within the
29  beam.

30

1   Thus at any given point within the beam path, a

2   constructive interference node can be made to

3   modulate with respect to the modulation frequency of

4   the laser, irrespective of the scattering of the path

5   to that point. This is because few areas of

6   constructive interference exist in the initial beam

7   and while a constructive node can occur at any point

8   which happens to have suitable path lengths through

9   the scattering medium to the source, the initially

10  cancelled portion of the beam can not be

11  reconstructed to become a constructive node at any

12  point. Since the modulation of the laser changes the

13  locations of the constructive nodes at the modulation

14  frequency of the laser the result is that for any

15  point (or more accurately for the substantial

16  majority of points) within the beam a modulation

17  occurs irrespective of the scattering nature of the

18  medium. This is because the probability of a scatter

19  from one sparse node to a region where another sparse

20  node has existed within frequency of the modulation

21  is extremely low.

22

23  In a typical coherent beam, the presence of

24  constructive or destructive interference is of equal

25  likelihood and the modulation of the beam will

26  generally shift one constructive node only to be

27  replaced by another causing any initial modulation of

28  the beam to swamped by the noise of the multiple

29  paths. In contrast, the limiting factor for the

30  modulation frequency of a sparse constructive

1    interference beam is simply that the overall maximum

2    path length of any substantial probability in the

3    Feynman diagram. Path length is substantially shorter

4    than the wavelength of the modulation.

5

6    For a depth of five or six centimetres in human

7    tissue this allows frequencies in excess of 10 MHz to

8    be successfully modulated and in many human tissues

9    such as bone or neural tissue the depth would be

10    substantially greater or the limiting frequency

11    higher.

12

13    A conventional coherent or incoherent beam would have

14    high probability paths in the Feynman diagram. These

15    paths would overlap at very low frequencies (kHz) and

16    be of little practical use in the stimulation of

17    molecular resonance. It should be noted however that

18    the phenomena described above may be used as a means

19    to multiply the modulation frequency, up to the point

20    where the beam effectively becomes continuous. Thus

21    by careful selection of the aperture, the region of

22    the beam selected for transmission through the medium

23    and the modulation frequency it is possible to cause

24    the constructive nodes to pass across any given point

25    in the beam at frequencies many times higher than the

26    modulation frequency. In ideal conditions the

27    duration of exposure to a constructive node of any

28    point would be for a period equivalent to a quarter

1    of the duration of a wavelength of the molecular

2    frequency repeated once per cycle.

3

4    If the wavelength of the laser is chosen to be one

5    easily absorbed by the atomic structures it is

6    desired to induce to resonance, then the beam will

7    efficiently deliver the desired modulation frequency

8    to the desired molecules. The energy of the beam is

9    extremely low but sufficiently high to differentially

10    raise the temperature of those molecules of

11    sufficient Q. Higher energy intensity would tend to

12    cause sufficient scatter even from the isolated

13    island nodes to swamp the modulation. Again the

14    result would be a general temperature increase rather

15    than the differential temperature increase of the

16    desired molecules.

17

18    Higher intensity can not significantly increase the

19    energy delivered to the desired molecules. Once the

20    probability of a single photon absorption at any

21    point on the molecule in a given and resonant

22    frequency cycle is exceeded, there is little

23    advantage in increasing the intensity since a second

24    photon will scatter without delivering more energy to

25    the given atom structure. The maximum temperature

26    difference that can be induced will be a function of

27    the damping factor and the Q of the resonant

28    component of the molecule. Therefore, increasing the

29    time of stimulation is pointless beyond some

1 reasonable multiple of the known time required to

2 initiate the reaction desired because the maximum

3 possible temperature variance will occur within a few

4 seconds.

5

6 The effect is therefore, only of merit in systems

7 where a small temperature variance can disturb the

8 equilibrium. Naturally this limits the range of

9 molecules that can be stimulated by this method. It

10 is fortunate however that many of the most usefully

11 stimulated molecules have exactly the characteristics

12 required. Most particularly the cell adhesion

13 molecules and integrins mentioned above. It should be

14 noted of course that all biological reactions occur

15 within a narrow temperature range and the progress of

16 most reactions can be varied quite significantly by

17 small temperature differences. It is of course a

18 natural consequence of light stimulation of a

19 molecular resonance that the molecular node

20 temperature of the resonant structure will coincide

21 with the maximum valence state of the atoms since

22 they are in the process of absorbing and emitting

23 photons and so the electrons are in general at a

24 relatively high energy state. Naturally specific

25 photochemical reactions will be favoured and this may

26 either help or hinder the ability of the method to

27 stimulate a specific desired reaction depending on

28 the proximity of unwanted photochemical reaction

29 sites to the resonant stimulated sites. In designing

30 a specific stimulus these factors should be taken

1    into account along with the equilibrium state and the

2    pH.

3

4    As stated above cell adhesion molecules and human

5    integrins such as Alpha 4 Beta 1 are ideally suited

6    for excitation to chemical activity by this method.

7

8    The stimulation of cell adhesion molecules and

9    integrins moderates a number of extremely useful

10   biological processes. Not least of these is cell

11   adhesion itself. It is obviously beneficial to

12   stimulate the adhesion molecules of a carcinoma as

13   the cell adhesion of carcinomas is relatively

14   depressed and enhancing the adhesion serves to reduce

15   the probability of metastasis. Such an effect would

16   be especially beneficial prior to the excision of a

17   tumour, reducing the likelihood of surgically

18   shedding carcinoma cells into the blood or lymph

19   system. The cell adhesion process and the integrins

20   especially Alpha 4 Beta 1 and Alpha 4 Beta 2 are

21   responsible not only for adhesion but also cell

22   recognition.

23

24   Bissel and Weaver have shown that by chemical

25   inhibition of adhesion sites of Alpha 4 Beta1, the

26   cell recognition can be moderated. It is therefore

27   possible to reduce an undifferentiated carcinoma cell

28   to its phenotype by correctly moderating the adhesion

29   reaction. The method used by Bissel and Weaver is

1 practical for in vitro application and can be used as
2 described in their patent for the measurement of
3 response to chemotherapy but it can not practically
4 be used in vivo. Conversely the laser radiation
5 method can be used in vivo and because of the
6 extremely low energies it is inherently safe at least
7 in terms of the radiation used. Care must of course
8 be taken to ensure that the stimulation delivered
9 will have a desirable consequence and much work is
10 needed to determine both the chemical responses that
11 are most easily stimulated and which of those are
12 desirable in a given case.

13

14 Gradually a library of reaction responses susceptible
15 to the stimulation will be developed from theory and
16 experiment and this library will be used to define a
17 range of reactions that are both of clinical use and
18 practical to stimulate. To date we have demonstrated
19 the stimulation of adhesion in leukocytes and neural
20 carcinomas. We have demonstrated substantial
21 moderation of cell surface chemistry in the prostate
22 gland.

23

24 This shows promise in the treatment of various
25 carcinomas. Stimulation of cell adhesion and
26 recognition alters the metabolism of the carcinoma
27 and causes induced, spontaneous apoptosis as a result
28 of undifferentiated cells communicating sufficiently.
29 This in turn causes the natural apoptosis of

1 undifferentiated cells in an undifferentiated

2 environment. We have substantial evidence that like

3 Bissel and Weaver we have observed the reduction to

4 phenotype of undifferentiated cells and leukocytes.

5

6 Wayner US5730978 has shown an integrin-moderated

7 process which suggests that the method may have

8 application in the treatment of auto-immune diseases

9 and in the manipulation of the immune response in

10 general.

11

12 In vitro, the method can be used to alter the

13 chemistry of a variety of proteins and simple amino

14 acid structures in a manner that may be useful in the

15 production of pharmaceutical compounds and nutrition

16 products. Since the polar and hydrophobic components

17 of molecules have substantially different electron

18 populations, Quantum Electrodynamics (QED) shows that

19 these components differentially absorb energy from

20 photons. Coupled with a modulation frequency close to

21 one of the major axes of a given molecule, modulated

22 laser stimulation can be used to increase the

23 homogeneity of a population of proteins or simple

24 amino acid structures. This can be highly

25 advantageous since the metabolic absorption of amino

26 acid structures is moderated in vivo by shape

27 specific enzymes.

28

1   If a simple amino acid nutrient is made homogeneous

2   the number of enzymes required to metabolise the

3   nutrient is reduced. Again the cascade effect of cell

4   chemistry means that such a reduction in the

5   complexity of a particular chemical process can

6   dramatically increase the speed of absorption

7   sometimes by several orders of magnitude since the

8   required enzyme population is far more rapidly

9   manufactured. This is of critical importance in many

10   simple amino acid nutrients since they have a limited

11   life before they are broken down by incidental

12   chemical effects before they can deliver the required

13   effect to the target cells.

14

15   Under ideal conditions it will be possible to order

16   the folding of a protein to the desired biological

17   form by successive stimulation of suitable resonant

18   frequencies and the differential polar and

19   hydrophobic absorption of photons. Again the

20   application of a suitable modulated beam to a

21   sufficient volume of protein by conventional means

22   would be impossible as result of the scattering of

23   the light. The sparse constructive node beam

24   disclosed in the present application makes the

25   delivery of the required modulation a practical

26   possibility. A suitable array of the disclosed sparse

27   constructive node beams could be arranged on a

28   conveyor passing the proteins or simple amino

29   structures sequentially under the various modulation

1  frequencies designed to favour each of the desired
2  folding steps.

3

4  Clearly much research would be required to determine
5  what modulations would be required to produce a
6  desired protein shape and it may be that in practice
7  very few proteins can be usefully manipulated in this
8  way. Such research is not within the scope of this
9  application; rather this application discloses a
10  method and apparatus capable of moderating aspects of
11  the folding process of proteins in a manner that can
12  be applied to a bulk mass for the first time. It is
13  extremely likely that a range of practical protein
14  structures can be generated by this method and it has
15  been shown by experiment that a population of
16  proteins or simple amino structures can be at least
17  made homogeneous which as mentioned above is useful
18  in itself.

19

20  In this regard it should be noted that the rotational
21  polarisation of the light source would cause
22  differential absorption of energy depending on the
23  "handedness" of a given molecular structure. In
24  addition, if the beam is modulated at the resonance
25  of a given structure, it is possible to either
26  enhance the production of one rotation of a molecule
27  versus the other. At slightly higher energy it is
28  possible to cause the destruction by a separate
29  chemical process of one or other rotation by

1 differentiating the temperature and therefore the

2 reactivity of one rotation versus the other. This is

3 a particularly useful application of the method as

4 many drugs and nutrients depend on only one form of

5 the molecule being present.

6

7 In this case of course the maximum Feynman path must

8 be very much shorter and so the maximum depth that

9 rotational polarisation effects would occur would be

10 no greater than a few millimetres in a typically

11 scattering medium. Hitherto no simple practical

12 method has existed to purify a population of

13 molecules to one or other rotation. The method

14 disclosed here provides a means of operating on bulk

15 media to generate a homogeneous single rotation

16 population or to allow a chemical process to

17 preferentially destroy one rotation relative to the

18 other in a mixed population of molecules.

19

20 The chemical consequences discussed herein of

21 molecular stimulation by sparse constructive node

22 techniques result primarily from the repeated

23 acceptance and release of photons by atoms at the

24 resonant frequency of the local atomic bonds or local

25 structure. There is a secondary effect on certain

26 molecular forms such as tetrahedral which can be

27 induced to spin provided the effective pulse length

28 is sufficiently short.

29

1   While the sparse constructive interference beam is

2   the primary thrust of the present application, it is

3   worth noting that the Hamiltonian solution to

4   Maxwell's equations suggest that cancelled light,

5   although carrying no energy in the conventional sense

6   in that it can not interact by conventional Quantum

7   Electrodynamics (QED) processes may have an effect on

8   the permitivity of free space and some theorists

9   suggest an effect on the strong nuclear force.

10   However since it can not scatter by QED effects this

11   has no detrimental affect on the efficiency of the

12   sparse constructive interference modulation and it

13   could be argued that the permitivity and nuclear

14   absorption effect, should it exist, would tend to

15   enhance the efficiency of the modulated frequency

16   coupling to the molecule. It should be noted that the

17   presence of the Hamiltonian effect has never been

18   satisfactorily proven and many theorists discount its

19   existence as a mere mathematical oddity, however we

20   note it here simply to point out that the effect

21   would tend to enhance rather than degrade the benefit

22   of the sparse constructive in interference effect.

23   The apparatus by its nature can therefor be used as a

24   means of delivering such a theoretical  modulated

25   Hamiltonian "scalar" wave.

26

27   Figs. 2 to 8 illustrate elements of the foregoing in

28   more detail.

29

1  Fig. 2 shows the sparse constructive interference

2  effect from a 1 percent bandwidth cancellation plate

3  of 5 mm aperture. Black represents constructive

4  nodes.

5  Fig. 3 shows the same sparse constructive

6  interference in a scattering medium showing minimal

7  degradation of the effect and an increased path width

8  of majority destructive interference.

9

10  Figs. 4 and 5 show typical Cell Adhesion Molecules.

11  Both would have two primary resonances a high Q

12  resonance between the main elements at a relatively

13  low frequency and a higher frequency lower Q

14  resonance between the lobes of each element. The

15  molecule in Fig. 4 has a higher frequency resonance

16  between the main elements as it has some backbone

17  structure between the main elements.

18

19  Fig. 6 shows a human integrin molecule which will

20  have a single substantial high Q resonance defined by

21  the mass of the two main elements and the compliance

22  of the single backbone structure between the

23  elements. This molecule is extremely easy to resonate

24  sufficiently to moderate reactions and was the first

25  molecule to be successfully manipulated by the method

26  disclosed. This allowed an in vitro demonstration of

27  cell adhesion stimulated  by laser stimulation

28  through a sparse constructive node cancellation

29  optical device. "Tracks" of adhered cell chains could

1   be generated in the beam path of the device in a

2   population of cells with substantially reduced

3   expression of the integrin and generally little

4   adhesion in the absence of the beam.

5

6   Fig. 7 shows the zinc "fingerlike" structure of the

7   GAG protein in the HIV virus. Again the molecule

8   shows the easily resonated dual element with

9   compliant single backbone bridge. This molecule is

10  much smaller and requires a higher energy and

11  resonant frequency. It was successfully resonated

12  with 470nm light using the method disclosed. It

13  should be noted that the chemical conditions around a

14  small viral particle are far harder to control or

15  predict and variable results are to be expected. Even

16  so substantial alterations in the processes of the

17  viral coat were observed and the viral penetration of

18  a cell population could be substantially altered.

19

20  Fig. 8 shows a typical laser diode spectrum, with a

21  typical cancelled portion of the spectrum and the

22  depth of the modulation that can be induced without

23  causing the nodes to spill outside the cancellation

24  zone and complicate the beat frequency pattern.

25  Different laser designs have different resonant modes

26  and these can be selected to obtain the most useful

27  range for a given application. Bragg gratings can be

28  used to stabilise the laser emission line and expand

29  the modulation amplitude that can be used while

1   keeping the overall frequency shift within the

2   required boundary. Lasers can be pulsed with short

3   duration pulses, which will produce an isolated

4   traverse though the frequency mode of the laser and

5   this can be determined to a high degree of

6   repeatability. If a Bragg grating is used with a

7   pulse laser the resulting frequency modulated pulse

8   will have a very high degree of control. The

9   combination of the short laser pulse and the rapid

10  resulting traverse of the sparse constructive nodes

11  means that a given point in the volume in front of

12  the laser will be exposed to extremely short (sub

13  picosecond) duration pulses. There are several

14  applications for such short pulses and conventional

15  methods for short pulse generation are relatively

16  costly.